

BIOENGINEERING / RIPARIAN HABITAT RESTORATION
SHEEP CREEK ROAD KM 5.5

prepared under

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by

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1.	Introduction	2
1.1	Scope	2
1.2	Background	2
1.3	Location and site description	3
2.	Site Rehabilitation Options	3
2.1.	Site 1 and 2	3
3.	Prescription and Layout	4
3.1.	Site 1 prescription	4
3.1.1	Site 1 layout	6
3.2.	Site 2 prescription	6
3.2.1.	Site 2 layout	7
3.3	Machine work	7
4.	Site Preparation	8
4.1.	Site 1 and 2	8
5.	Implementation and Treatment	8
5.1.	Collection and Preparation of Materials	8
5.2.	Preparation of Structures	10
5.3.	Summary of treatment types by site	10
5.4.	Installation of Structures	10
5.5	Hydro seeding grasses and legumes	11
5.6	Planting of native seedlings	11
6.	Cost Breakdown	11
6.1.	Site 1 and 2 Cost Breakdown	11
7.	Recommendations	12
7.1	Monitoring	12
7.2	Maintenance	12
8.	Sources cited	12

APPENDICES

I Bioengineering Information

- Fascines
- Soil binding and stabilization capability
- Tensile and shearing strength
- Live fascine used in live pole drains

II Maps

- #1; Sheep Creek site locations and live materials collection areas

III Photo Mosaics

- #1; Site 1 and 2, Prior to commencing work
- #2; Site 1, Work completed
- #3; Site 2, Work completed

IV Photodocumentation Form

- Photos

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1. Introduction

1.1. Scope

Global Forestry Consulting was retained by Ministry of Transportation and Highways (MOTH) of the Central Kootenay District in September 2000 to field review a debris slide/earthflow at approximately 5.5 km on the Sheep Creek road near Salmo, B. C., make prescriptive recommendations for soil bioengineering treatments and maintenance, and then complete the installation of stabilizing structures in May of 2001. This report describes in detail the work undertaken. The treatments are intended to restore the stability of the slide site above the road and stream bank below the road in this location, while at the same time restoring riparian cover and function as relates to local fish habitat conditions. The treatment should also reduce the annual spring event of flowing mud over the Sheep Creek road section adjacent to the slide site. As well the treatment should reduce sedimentation of Sheep Creek resulting both from surface erosion and from stream erosion at high flow.

1.2. Background

Sheep Creek is a major tributary of the Salmo River. The Salmo River and tributaries have long been recognized as prime spawning and rearing habitat for migratory bull and rainbow trout (personal com. with Paul Grutter B.Sc. RL&L Environmental Services Ltd.) The area is also a prime habitat for the harlequin duck. The debris slide and earth flow at the failure site originally occurred between the fall of 1998 and the spring of 1999 (inf. obtained from MOTH Creston Office). No other attempt to re-habilitate the site was carried out before the soil bioengineering treatment described in this report. The only activities that took place were the clearing of debris and mud from the road by the MOTH maintenance contractor. An example of flowing materials is shown in plate #1. These events have obstructed spring access to residents beyond the slide as well as people using the road for access for work or recreational activities. The ongoing instability and sedimentation at site 1 above the road and site 2 below the road required treatment to reduce site instability and sediment delivery to Sheep Creek.



Plate # 1, Mud/earth flow into ditch spring 2001

1.3 Location and site description

The project area is located in the lower Sheep Creek drainage, approximately 11-km southeast of Salmo. The restoration treatment site is located along the Sheep Creek road at approximately 5.5 km upstream of the Salmo River confluence. (see map # 1, appendix II). Site 1 is located above the road and site 2 is located directly below the road.

Estimated area of Site1 and 2: ~ 0.1 ha.

Ref. map: SALMO 82 F/3

Biogeoclimatic zone / subzone: ICH dw

Elevation: 823 m

Aspect: South

2. Site Rehabilitation Options

2.1. Sites 1 and 2

The main failure, designated site 1 in this report, is a debris slide/earth flow, which occurred above the Sheep Creek road and failed/flowed onto the road. Approximate dimensions of the failure are 30 m. wide by 46 m. length by a height at the failure headwall of about 10 metres. Gradients on the slide face range from 80 to 150% and from 30 to 60% on the debris at the toe of the slide. The material is primarily glacio- lacustrine inbedded silt and sand with some clay. In places the materials are varved. (see plate #2). The glaciolacustrine materials are overlain by glaciofluvial sand and gravel. The glaciofluvial materials are dry and well to rapidly drained. The galciolacustrine materials are poorly drained and include extensive areas of seepage. The water table is perched on silt and clay layers in a number of locations. At the site below the road, designated site 2 in this report, is a failing bank where material from the debris slide has been sidecast directly into Sheep Creek. The material on the failing portion of the bank, which is about 31 m long by 10 m wide, has sloughed and ravelled into the creek. The bank gradients are 80 to 100%.

The initial debris slide and earthflow occurred sometime between the fall of 1998 and the spring of 1999 (source MOTH, Creston Office). The cause of the failure is not clear. It may be related to old mining-activities, which altered the drainage patterns on the area upslope. Inspection of the area immediately upslope did not reveal obvious drainage concentration. Removal of toe support in the construction of the road and subsequent ditch cleaning is likely to have been a factor contributing to the failure.

In September 2000 the site was field visited by representatives of the Ministry of Transportation and Highways and Global Forestry Consulting to assess the site conditions and develop a site prescription for soil bioengineering treatment on sites 1 and 2 and minor ditch line and road work. The Ministry of Transportation and Highways representative stated objectives, to be stabilization of the slope and control of the water to avoid further road obstruction problems. The prescription was further modified after consultation with D. Polster M.Sc. R.P. Bio. of Polster Environmental Services. A second field visit was carried out in order to fine-tune the prescription by P. Raymond of Global Forestry Consulting and D.Putt P.Ag., P.Geo. of Forterra Consulting Ltd.



Plate #2; Site 1 and 2, Fall 2000, prior to rehabilitation

3. Prescription and Layout

3.1. Site 1 Prescription

Based on the field visit, site characteristics, and consultation with D. Polster and D. Putt, the following prescription and layout was applied to the site. Modified brush layers (25) were installed in the sandy area at the upper section of the site. These structures should stop the ravelling created by the steepness (100 to 150%) of the sands and gravels and help establish vegetation (see plate #3). The use of contour fascines (see plate #4) and drain fascines in combination with central live pole drains system should help control the excess surface water and seepage on the site (see plate #5). As these structures are partially buried they should be more resistant to the summer drought. These structures will also act as a sediment trap to catch flowing sediment as the woody vegetation sprouts from the fascines. In the area directly above the ditch line the combination of live fascine bundles (25 cm in diam.) placed on a brush layer of 1.0-m. cuttings (see plate #6) should provide support to retain materials and prevent sloughing into the ditch.



Plate #3; Site 1, Modified brush layers in sandy area



Plate #4; Site #1, Contour fascines and modified brush layers



Plate #5; Site #1, Live pole drains/drain fascines and live stakes



Plate #6; Site #1, Brush layer and contour fascines installations

Pieces of semi rotten logs were placed on top of the cuttings at the base of the brush layer to provide organic materials and oxygen to enhance root growth. Live stakes (480) were prescribed at the bottom of the site above the road within the debris in the slide runout zone (see plate #5). The root mass produced from the live staking should intertwine together and help stabilize the accumulated materials. Wattle fences were also installed above the live pole drains to retain materials and prevent them from falling and obstructing the drains. Hydro seeding of grasses and legumes mix and container type Sitka mountain alder seedlings were also prescribed to reduce surface erosion and increase the slope stability.

3.1.1. Site 1 Layout

A prescription sketch (see photo mosaic #2, Appendix II) shows the site features and established structures.

3.2. Site 2 Prescription

Based on the field visit, site characteristics, and consultation with D. Polster and D. Putt, the following prescription and layout was carried out on the site. The site has a composite of the materials up slope (site 1) which have been sidecast (gravel, sand and silt). The planting directly below the road grade of a combination of live fascine bundles (25 cm in diam.) placed on a brush layer using 0.8-m cuttings should provide support to retain and hold the unstable sidecast material. Modified brush layers (16) were installed in a staggered pattern, between the road and the high water mark directly below the contour fascines/brush layer structure. These modified brush layer structures should stop the ravelling and help establish vegetation (see plate #7). Hydro seeding of grasses and legumes mix, in addition to container type Sitka mountain alder seedlings, was prescribed to reduce surface erosion and increase the slope stability.



Plate #7; Modified brush layers installations below road

3.2.1. Site 2 Layout

A prescription sketch (see photo mosaic #3, Appendix II) shows the site features and established structures.

3.3 Machine Work

A mini John Deere excavator was used to conduct minor machine work. The ditch line was cleared of debris and soil and one additional metal culvert (300 mm. In diam.) with plastic flex pipe to carry water down the bank was installed, 21 meters west of an existing metal culvert. The intakes of the existing and new culvert were armoured to prevent bank sloughing and plugging of the culvert (see plate #8,9). As well the excavator was used to excavate the lower portions of the live pole drains system and both the contour fascines/brush layer structures at the toe of site 1 and at the top of site 2.



**Plate #8; East of site #1,
Prior to culvert installation**



**Plate #9; East of site #1,
Installed culvert and armoring**

4. Site preparation

4.1 Site 1 and 2

All wildlife / dangerous trees were assessed by a certified assessor and felled as per W.C.B. regulations. Smaller trees and shrubs were felled above the headwall scarp of site 1 to prevent wind fall which might destabilize the scarp. The scarp was shaved using hand tools to reduce slope angle. Cables were installed in appropriate locations to secure workers for use of climbing harness while installing structures and carrying out on site work. Both sites were rock scaled to remove all loose rock and debris and ensure safe work sites (see plate #10).



Plate #10; Site1, Site preparation, rock scaling

5. Implementation and Treatment

5.1 Collection and Preparation of Materials

All willow, cottonwood and red osier dogwood cuttings (a mix of approximately 75% cottonwood, 10% willow and 15 % red osier dogwood) were gathered in the vicinity of the first 5km of the Sheep Creek road southwest of the slide site. (see map # 1, appendix II). The material was collected from April 18 to April 24, 2001.

Modified brush layers cuttings and cuttings used for brush layer portion of the contour fascines/brush layer structures were treated in the following way;

- the portion of the cutting to be buried was dipped in a mix of polymer moisture retainer and root hormone The polymer moisture retainer and root hormone application will help retain the available moisture for the plant and help the initial rooting.
- the exposed portion of the cuttings was painted with a mix of 50% latex paint and 50% water. The mix of 50% latex paint and 50% water application will help avoid desiccation and prevent disease entry.



Plate #11; Fascines bundle constructions



Plate #12; Live stakes preparations



Plate #13; Live materials stored in Sheep Creek

5.2 Preparation of Structures

A total of 81 fascines / live pole drain bundles were gathered and constructed on site. The dimensions varied from 4 metres in length by 16 to 20 cm in diameter, for the drain fascines and contour fascines, to 4 metres in length by 30 cm in diameter for the live pole drains (see plate # 11, 12). The various fascines and live pole drain bundles were built with an average of 12 to 15 cuttings per bundle, with cuttings varying from 2 to 8 cm in diameter and 1 to 4 metres in length. All fascines and live pole drains were anchored with 15 mm rebar x 0.6 m and 15 mm rebar x 1.3 m with a "T" (6" cross piece) welded at one extremity to insure firm placement. The cuttings gathered for the wattle fences were 19 regular bundles of 12 stems per bundle varying from 2 to 8 cm in diameter and 2 to 4 metres in length. As well, 820 stakes of 0.6 meter, 245 stakes of 0.8 meters, 148 stakes of 1.0 meters and 400 stakes of 1.5 metres were gathered. The stakes varied from 2 to 15 cm in diameter. Each modified brush layers was built using 20 cuttings of 0.6 m and anchored with 2, 15 mm rebar x 1.3 m placed in front of a 1" x 8" board of 6.5' in length. The live materials were transported and stored in Sheep Creek adjacent to about 3km on the Sheep Creek road. They were enclosed within a metal fence supported by rebar to protect the live cuttings from beaver damage. All live materials were stored in water for a period varying from 6 up to 8 days to help promote root initialization. (see plate #13).

5.3 Summary of treatment types by site

Site 1

- installation of 30.0 m of contour fascines/brush layers using 1.0 m cuttings.
- installation of 190.0 m of contour and drain fascines,
- installation of 95.0 m of live pole drain,
- installation of 25 modified brush layers,
- installation of 22 m of wattle fences
- planting of 400 live stakes using 1.5 m. cuttings
- planting of 80 live stakes using 0.6 m. cuttings
- planting of 340 Sitka mountain alder plugs, PSB 412A 1+0
- Hydro seeding of grasses and legumes mix
- fertilizer 18-18-18-2SCU @ 300 kgs/ha
- wood-fiber mulch @200 kgs/ha
- tackifier @ 50 kgs/ha

Site 2

- installation of 31.0 m of contour fascines/brush layers using 0.8 m cuttings.
- installation of 16 modified brush layers,
- planting of 60 Sitka mountain alder plugs, PSB 412A 1+0
- Hydro seeding of grasses and legumes mix
- fertilizer 18-18-18-2SCU @ 300 kgs/ha
- wood-fiber mulch @200 kgs/ha
- tackifier @ 50 kgs/ha

5.4 Installation of Structures

A crew of 7 people installed the structures listed above on April 16 to May 1, 2001. In most locations the ground was very moist at the time of installation. Hydroseeding was carried out on May 2, by Interior Reforestation Ltd.

5.5 Hydro seeding grasses and legumes

The hydro seeding prescription was developed by David Polster M.Sc. R.P. Bio. of Polster Environmental Services. This high seeding rate of 30 kg /ha. was to allow for the different site types (soup to concrete). Some species (e.g. Redtop) will do well in the moist areas, while others will do well in the dry areas (e.g. Hard Fescue). Along with the seed the following materials were applied: 200 kg/ha of wood fiber mulch and 50 kg/ha of guar gum tackifier and 300 kg/ha of 18-18-18-2SCU fertilizer.

Balanced Successional Seed Mix for Sheep Creek Bioengineering Sites

Species	Percent by Weight	Percent by Species Composition
Boreal Creeping Red Fescue	7.7	10
Durar Hard Fescue	12.1	15
Climax Timothy	5.5	15
Barlano Perennial Ryegrass	25.3	15
Redtop	1.0	10
Rangelander Alfalfa	39.0	20
Aurora Alsike Clover	9.4	15

5.6 Planting of native seedlings

A total of 400 Sitka mountain alder (*Alnus viridis* ssp. *sinuata*) PSB 412A 1+0 were planted on the lower portion of site 1 and on site 2. The Sitka mountain alder adds a deep-rooted and nitrogen fixing component to the sites.

6.0 Cost Breakdown

6.1 Site 1 and 2 Cost Breakdown

* Soil bioengineering prescription fall 2000:	\$660.00
Preparation of site for works:	
Including: excavation to install structures, rock scaling, slope shaving and hazardous tree falling and clearing.	\$1,275.00
Implementation of works:	
Including the installation of the following: 41 modified brush layers 190 metres of live contour fascines 95 metres of live pole drains 22 metres of wattle fences 61 metres of brush layer/contour fascines 480 live stakes Hydro seeding Planting of 400 alder plugs	\$20,548.00
Report, including photo mosaic and photo documentation	<u>\$1,200.00</u>
Sub-Total:	\$23,023.00
Total:	\$23,023.00
* The prescription was developed in the fall of 2000 under MOTH budget	

7. Recommendations

7.1 Monitoring

The site was visited on June 25, 2001. Early growth of all structures including the Sitka mountain alder, grasses and legumes was found satisfactory (see photos #37 to 42). About 95% of the structures had sprouted. The live pole drains were functioning. Minor sloughing and raveling onto some of the existing structures had occurred. The sites should be monitored again in the early spring of 2002 to evaluate the stabilizing and growth performance of the established structures and to determine the need for structure maintenance and repairs as well as an assessment for potential extra structure requirements. Monitoring should take place again in the spring of 2003.

7.2 Maintenance

Summer 2001

- Re-establish the ditchline below site 1 up to the second culvert east of site using a grader. Inslope road @ 3% along the bottom of site 1 and east of the site up to the existing culvert as recommended in the prescription.
- Watering of the site during the summer of 2001 may be required if the weather becomes hot and dry for a long period of time.

Fall 2001

- Pruning of the first year growth during late fall is recommended to avoid desiccation and enhance root growth.
- Minor repair of existing structures and the addition of a few additional structures in strategic locations may be required.

8. Sources cited

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